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PERIPHERAL I/O DEVICE CONTROL USING MICRO BLAZE PROCESSOR

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ABSTRACT

Embedded Development Kit (EDK) tools are used for this purpose to enables a design of a complete embedded processor system for implementation in a Xilinx FPGA device. The Micro Blaze embedded soft core processor is a reduced instruction set computer (RISC) optimized for implementation in Xilinx Field Programmable Gate Arrays. In this paper the authors presented the controlling of the peripherals like LED`s, push buttons and seven segment display through UART Communication. Universal Asynchronous Receiver Transmitter (UART) Lite Interface connects to the PLB (Processor Local Bus) and provides the controller interface for asynchronous serial data transfer.

Keywords: PLB, EDK, UART, FPGA, LED`s, push buttons.

1. INTRODUCTION

The microprocessors available for use in Xilinx Field Programmable Gate Arrays (FPGAs) with Xilinx EDK software tools can be broken down into two broad categories. There are soft-core microprocessors (Micro Blaze) and the hard-core embedded microprocessor (PowerPC). The Micro Blaze is a virtual microprocessor that is built by combining blocks of code called cores inside a Xilinx Field Programmable Gate Array (FPGA). The beauty to this approach is that you only end up with as much microprocessor as you need. FPGA contains programmable logic components called logic blocks and a hierarchy of reconfigurable interconnects that allow the blocks to be wired together. Logic blocks can be configured to perform complex combinational functions or merely simple logic gates like AND and XOR. In most of the FPGA`s the logic blocks also include memory elements which may be simple flip flops or more complete blocks of memory. You can also tailor the project to your specific needs like Flash, UART, General Purpose Input/output pheriphals and etc.

By using the serial communication we are going to monitor the output of the peripherals like Seven Segment Display, LED`s, Dip Switches, push buttons which are present on the Diligent Nexys Board. Micro Blaze EDK has numerous IP cores that give designers pre-made modules through user friendly software. The Nexys2 board includes several input devices, output devices, and data ports, allowing many designs to be implemented without the need for any other components. Four pushbuttons and eight slide switches are provided for circuit inputs. Pushbutton inputs are normally low, and they are driven high only when the pushbutton is pressed. Slide switches generate constant high or low inputs depending on their position. Pushbutton and slide switch inputs use a series resistor for protection against short circuits. The outputs will be observed on the putty terminal with the commands through given through UART communication.

2. UART COMMUNICATION

A universal asynchronous receiver transmitter (UART) is basically a parallel to serial data transmitter and a serial to parallel data receiver. The asynchronous part refers to the fact that the clock for the UART does not have to be synchronized to either the transmitting or receiving systems' clocks. A modem is composed of two basic parts, the UART and the analog modulator-demodulator, which is where the term (MoDem) comes from. During transmission of data the UART is responsible for taking the data from the host machine and turning it into a serial bit stream that can be sent by the modem over the phone line. During reception of data the UART takes the serial data from the modem and converts it into parallel data that can be used by the host machine. Standard UARTs transmit and receive data in 11-bit packets, of which 8-bits are for the data, there is one bit at the beginning of the packet called the Start bit, which is always a logic 0, and 2 bits at the end called the Stop bits, which are always a logic 1.

As a Receiver

The two basic parts of the UART receiver are a bit-sampling clock, which runs at least 16 times faster than the bit rate, and a bit counter. The idle state of the transmission line is at a logic high level. When data is being sent the transmission line drops because of the start bit. The UART senses this change and counts off 8 increments of the bit-sampling clock to find the middle of the start bit (assuming this clock is running 16 times faster than the bit-rate). Then the bit-sampling clock is reset and every time the bit-sampling clock reaches a count of 16 the transmission line is sampled and the bit counter is incremented. When all eight bits have been collected, the UART looks for the stop bits and then sends the data to the host machine.

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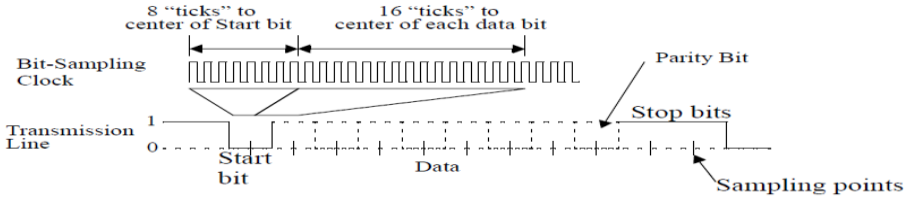

Fig 1. UART communication as reciever.

As a Transmitter

The UART Transmitter is composed of three basic parts.

1) A parallel-load shift register,

2) A transmission line flip-flop, and

3) Logic that generates a "register-empty" flag.

Data is loaded in parallel fashion into the shift register, and then shifted out serially to the Line flip-flop, which holds the transmitted data for one clock cycle. Remember you must also append the Start and Stop bits to the data in the shift register. As a bit leaves the shift register, 0's are shifted into the "empty" slots of the shift-register. The flag logic should detect when the shift register has all zeros (i.e. the Stop bits have left the shift register), and set a flag that the transmission is complete. Upon completion of a successful transmission, the shift register should then load in the next byte of data.

3. EXPERIMENTAL SET UP

In this paper the authors had implemented the experimental set up on Diligent Nexys2 board, which consider of the required peripherals for the evaluation of the paper. The detail explanation of each peripheral is as follows.

Seven segment display

The Nexys2 board contains a four-digit common anode seven-segment LED display. Each of the four digits is composed of seven segments arranged in a "figure 8" pattern, with an LED embedded in each segment. Segment LEDs can be individually illuminated, so any one of 128 patterns can be displayed on a digit by illuminating certain LED segments and leaving the others dark. Of these 128 possible patterns, the ten corresponding to the decimal digits are the most useful. The anodes of the seven LEDs forming each digit are tied together into one "common anode" circuit node, but the LED cathodes remain separate. The common anode signals are available as four "digit enable" input signals to the 4-digit display.

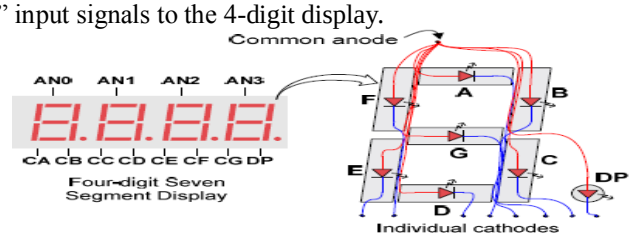

Fig 2. Digilent nexys2 Seven segment Display.

A scanning display controller circuit can be used to show a four-digit number on this display. This circuit drives the anode signals and corresponding cathode patterns of each digit in a repeating, continuous succession, at an update rate that is faster than the human eye can detect.

LED`s

The Nexys2 board includes several input devices, output devices, and data ports, allowing many designs to be implemented without the need for any other components. Eight LEDs are provided for circuit outputs. LED anodes are driven from the FPGA via 390-ohm resistors, so a logic '1' output will illuminate them with 3-4ma of drive current. A ninth LED is provided as a power-on LED, and a tenth LED indicates FPGA programming status.

Push Buttons

Four pushbuttons and eight slide switches are provided for circuit inputs. Pushbutton inputs are normally low, and they are driven high only when the pushbutton is pressed. Slide switches generate constant high or low inputs depending on their position. Pushbutton and slide switch inputs use a series resistor for protection against short circuits and a short circuit would occur if an FPGA pin assigned to a pushbutton or slide switch was inadvertently defined as an output.

Fig 3. Diligent Nexys2 I/O devices.

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4. RESULTS AND DISCUSSION

The outputs are obtained by giving he commands to the respective peripharals and checking the out put on the digilent nexys board. For the given commands the outout will be displayed based on the UART Communication. The following figures shows the output of the peripharl controlling by the UART communication. By using the XIlnix10.1 EDK tool the following results are obtianed.

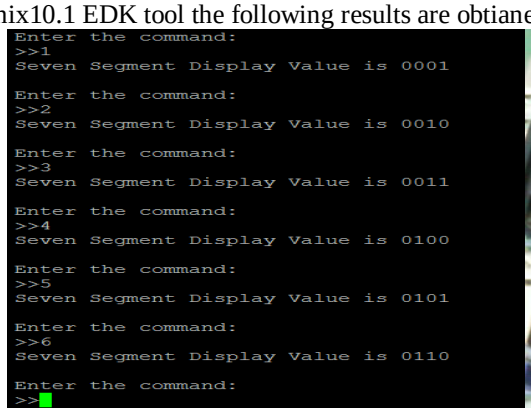

Fig 4. Commands to seven segment Display unit

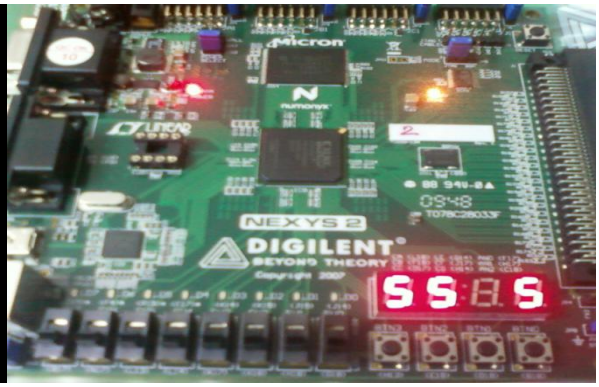

Fig 5. Out put on Nexys board with respect to command.

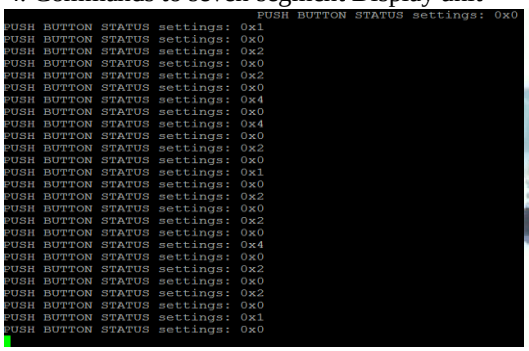

Fig 6 status of Push buttons

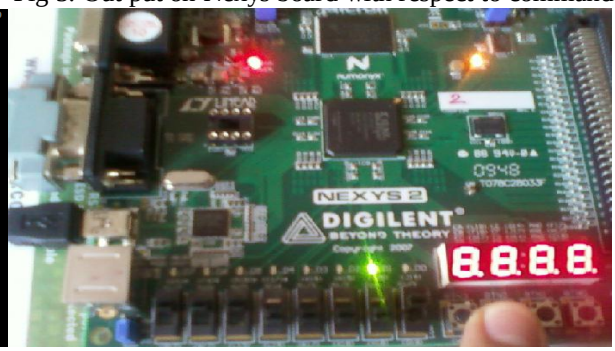

Fig 7 output of pushbuttons while led`s on

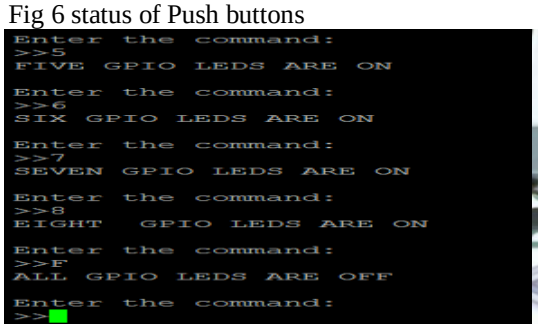

Fig 8 Commands to LEds

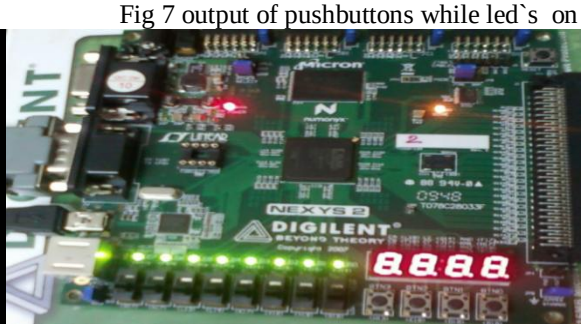

Fig 9 Out puts on nexys board.

5. CONCLUSION

The objective was achieved by designing an embedded based project on EDK using Micro Blaze as a processor where the operations are performed by the processor and developed on XILINX 10.1 and implementing the code in C language. By this we can conclude that by using a serial communication we can control the Input/output peripherals which will be having applications like controlling the traffic lights etc. The out puts are verified by giving the commands in the putty terminal and we can see the output status of each peripheral on the same terminal also.

6. ACKNOWLEDGMENTS

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